

Appl. No. 10/676,585
Amdt. Dated June 15, 2006
Reply to Office action of March 16, 2006

REMARKS/ARGUMENTS

Claims 11-28 are pending in the present application.

This Amendment is in response to the Office Action mailed March 16, 2006. In the Office Action, the Examiner rejected claims 11-28 under 35 U.S.C. §102(e); and claims 13-14, 11-28 under 35 U.S.C. §103(a). Applicants have amended claims 11 and 21. Reconsideration in light of the amendments and remarks made herein is respectfully requested.

Response to Examiner's Arguments

In the Office Action, the Examiner states that "the instant claims do not exclude the formation of thermoelectric film at the other location or entire area on the surface of the chip" (Office Action, page 6, first paragraph). Applicants respectfully disagree. The thermoelectric film is located at an area localized on the wafer. A localized area occupies a portion of the entire surface and therefore excludes areas that are outside the localized area.

The Examiner further states that Macris discloses the heat source from an IC chip of electronic component (localized heat source), citing paragraph [0075], lines 4-5, and [0077], last 3 lines (Office Action, page 6, first paragraph). However, these excerpts do not disclose that the thermoelectric film is located at a localized area.

The Examiner further contends that "the thermoelement from Macris is the same as in the instant thermoelectric film regardless of how it is made" (Office Action, page 6, second paragraph). However, Applicants argued in the previous response that the thermoelement is structurally different from the thermoelectric film. It is the Examiner's burden to prove that the thermoelement formed by bonding between a conductor/semiconductor to a dissimilar conductor/semiconductor and covering the entire are of the chip structure is the same as an individual thermoelectric film located at a localized area.

Rejection Under 35 U.S.C. § 102

In the Office Action, the Examiner rejected claims 11, 12, 15-21, 25, -28 under 35 U.S.C. §102(e) as being anticipated by U.S. Publication No. 2002/0063330 issued to Macris ("Macris"); and claims 11-28 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,614,109

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issued to Cordes et al. ("Cordes"). Applicants respectfully traverse the rejection and contend that the Examiner has not met the burden of establishing a prima facie case of anticipation.

1. Claims 11-12, 15-21, and 25-28:

Macris discloses a heat sink/heat spreader structures and methods of manufacture. A thermoelement couple comprises at least one heat absorbing junction 30 and two heat rejecting junctions 32 (Macris, paragraph [0113]). The heat absorbing junction is positioned near the center of the thermoelement face 28a and the heat rejecting junction 32 is positioned near the perimeter of the thermoelement face 28a (Macris, paragraph [0082]).

Macris does not disclose, either expressly or inherently, at least one of: (1) the thermoelectric film being located at a location matched to an area that needs thermal control, as recited in independent claims 11 and 21, and (2) the thermoelectric film being selectively turned on or off by a power controller as recited in dependent claims 27 and 28.

First, Macris discloses the entire heat sink/spreader structure 56 acting as a thermoelement couple, not an individual thermoelectric film fabricated on a bare wafer or a substrate. The thermoelement couple is created through the bonding between a conductor or semiconductor 28 to at least one dissimilar conductor or semiconductor 35 (Macris, paragraph [0113]). Therefore, the thermoelement couple is not a thermoelectric film fabricated on a bare wafer.

Second, Macris merely discloses the heat absorbing is positioned near the center of the thermoelement face 28a and the heat rejecting junction 32 is positioned near the perimeter of the thermoelement face 28a (Macris, paragraph [0082]). Since these locations are fixed with respect to the thermoelement material 28, they are not matched to localized areas that need thermal control as recited in amended claims 11 and 21. To clarify this aspect of the invention, claims 11 and 21 have been amended.

Regarding claims 27, and 28, the Examiner contends that the bare wafer 28 has power signal 22 to control the at least thermoelectric film, citing [0077] (Office Action, page 3, last two lines). Applicants respectfully disagree. The power leads 22 are used only to apply electric potential across the heat sink 12 and induces charge carrier flow 24 (Macris, paragraph [0077]), not to selectively turn on or off the thermoelectric film. The heat sink 12 is either powered or not powered by the power leads. There is no selectivity in turning on or off the heat sink 12.

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2. Claims 11-28:

Cordes discloses a method and apparatus for thermal management of integrated circuits. An integrated thermo-electric cooler 510 having modules of p-type and n-type thermoelectric elements capable of cooling portions of integrated circuit 403 (Cordes, col. 7, lines 53-58). The thermoelectric cooler 510 is formed by forming n-type and p-type elements during the fabrication of the semiconductor device (Cordes, col. 5, lines 5-27; col. 6, lines 1-27; Figure 2C, element 328, 330, 358, and 360). A hot end 338 is assembled to cold end 301 (Cordes, col. 6, lines 30-31). Two p-type thermoelectric elements are made from a composition of $\text{Bi}_{0.5}\text{Sb}_{1.5}\text{Te}_{0.3}$ formed by a pulsed electrochemical deposition process wherein alternating layers of BiTe and SbTe of predetermined compositions form the desired composition of $\text{Bi}_{0.5}\text{Sb}_{1.5}\text{Te}_{0.3}$ (Cordes, col. 6, lines 5-11).

Cordes does not disclose, either expressly or inherently, at least one of: (1) the thermoelectric film being located at a location matched to an area that needs thermal control, as recited in independent claims 11 and 21, and (2) the thermoelectric film being selectively turned on or off by a power controller as recited in dependent claims 27 and 28.

First, Cordes merely discloses fabricating the n-type and p-type thermoelectric elements as part of the composite semiconductor device fabrication. The thermoelectric elements 328, 330, 358, and 360 are sandwiched between the hot end 338 and the cold end 301 (Cordes, col. 6, lines 28-35; Figure 2C). Cordes, therefore, does not disclose a bare wafer and thermoelectric film on the bare wafer, and a substrate bonded to a die.

Second, the thermoelectric elements are not individual thermoelectric attached to the bare wafer or the substrate. They are fabricated using pulsed electrochemical deposition process or bulk plating process (Cordes, col. 5, lines 12, lines 14-15).

Regarding claim 17, Cordes merely discloses selecting a semiconductor substrate 302 to form a cold end 301 (Cordes, col. 4, lines 23-24), and a substrate 339 as a starting material to form a hot end 338 (Cordes, col. 5, lines 31-33). None of these substrates is thinned.

Regarding claims 27-28, the Examiner refers to Cordes, col. 6, lines 64-67. However, the cited excerpt merely states that "[p]roperly applying a DC voltage enables integrated thermoelectric cooler 310 to transfer thermal energy from the SOI integrated circuits formed in

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and onto layer 309.” (Cordes, col. 6, lines 64-67). The DC voltage does not selectively turn on or turn off the at least thermoelectric film.

Therefore, Applicants believe that independent claims 11 and 21 and their respective dependent claims are distinguishable over the cited prior art references. Accordingly, Applicants respectfully request the rejection under 35 U.S.C. §102(e) be withdrawn.

Rejection Under 35 U.S.C. § 103

2. In the Office Action, the Examiner rejected claims 11-28 under 35 U.S.C. §103(a) as being unpatentable over Cordes in view of U.S. Patent No. 6,222,113 issued to Ghoshal (“Ghoshal”). Applicants respectfully traverse the rejection and contend that the Examiner has not met the burden of establishing a *prima facie* case of obviousness.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *MPEP §2143, p. 2100-129 (8th Ed., Rev. 2, May 2004)*. Applicants respectfully contend that there is no suggestion or motivation to combine their teachings, and thus no *prima facie* case of obviousness has been established.

Cordes discloses a method and apparatus for thermal management of integrated circuits as discussed above under the §102 rejection.

Ghoshal discloses an electrically-isolated ultra-thin substrates for thermoelectric coolers. Thermoelectric cooling apparatus 400 is made using the semiconductor-based thermal sinks having doped regions (Ghoshal, col. 5, lines 61-63) in conjunction with an array of thermoelectric elements (Ghoshal, col. 6, lines 14-16). Micro-size cooling apparatus is selectively bonded to parts of an integrated circuit chip for purposes of selective region cooling to control integrated circuit parameters (Ghoshal, col. 8, lines 53-56).

Cordes and Ghoshal, taken alone or in combination, do not disclose, suggest, or render obvious, at least one of (1) the thermoelectric film being located at a location matched to an area that needs thermal control, as recited in independent claims 11 and 21, (2) the thermoelectric

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film being selectively turned on or off by a power controller as recited in new dependent claims 27 and 28, and (3) the thermoelectric film being made by an alloy being one of Bi_2Te_3 , Sb_2Te_3 , and Zn_4Sb_3 , as recited in claims 14 and 24. There is no motivation to combine Cordes and Ghoshal because neither of them addresses the problem of integrating thermoelectric elements into wafer at locations that needs heat extraction. There is no teaching or suggestion that such as location of thermal control is present. Cordes, read as a whole, does not suggest the desirability of using one of Bi_2Te_3 , Sb_2Te_3 , and Zn_4Sb_3 alloys.

Cordes does not disclose or suggest individual thermoelectric films on a bare wafer or substrate as discussed above. Cordes merely discloses a composition of $\text{Bi}_{0.5}\text{Sb}_{1.5}\text{Te}_{0.3}$, not Bi_2Te_3 , Sb_2Te_3 , and Zn_4Sb_3 . Furthermore, as discussed above, Cordes discloses using a pulsed electrochemical deposition process or a bulk plating process to form the thermoelectric elements, not using bonding two wafers.

Ghoshal merely disclose fabricating the cooling apparatus using thermal sinks in conjunction with thermoelectric elements (Ghoshal, col. 5, lines 61-63; col. 6, lines 14-16). Since they are fabricated together during the MEMS and/or device fabrication process, they are not individual thermoelectric films on bare wafer or substrate.

Regarding claim 17, Ghoshal does not disclose or suggest thinning the bare wafer or the active wafer. Ghoshal merely disclose a semiconductor wafer is prepared using conventional bulk CMOS processing techniques (Ghoshal, col. 7, lines 14-15). Since only conventional techniques are used, the wafer or the substrate is not thinned.

Regarding claims 27-28, Ghoshal does not disclose or suggest selectively turning on or off the thermoelectric films or elements. As shown in Figure 9, the thermoelectric cooler is attached to a heat sink and as a block. Therefore, it does not have individual thermoelectric elements to be selectively turned on or off.

When applying 35 U.S.C. 103, the following tenets of patent law must be adhered to: (A) The claimed invention must be considered as a whole; (B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination; (C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention; and (D) Reasonable expectation of success is the standard with which obviousness is determined. Hodosh v. Block Drug Co., Inc., 786 F.2d 1136, 1143

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n.5, 229 USPQ 182, 187 n.5 (Fed. Cir. 1986). "When determining the patentability of a claimed invention which combined two known elements, 'the question is whether there is something in the prior art as a whole suggest the desirability, and thus the obviousness, of making the combination.'" In re Beattie, Lindemann Maschinfabrik GmbH v. American Hoist & Derrick Co., 730 F.2d 1452, 1462, 221 USPQ (BNA) 481, 488 (Fed. Cir. 1984). To defeat patentability based on obviousness, the suggestion to make the new product having the claimed characteristics must come from the prior art, not from the hindsight knowledge of the invention. Interconnect Planning Corp. v. Feil, 744 F.2d 1132, 1143, 227 USPQ (BNA) 543, 551 (Fed. Cir. 1985). To prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the Examiner to show a motivation to combine the references that create the case of obviousness. In other words, the Examiner must show reasons that a skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the prior elements from the cited prior references for combination in the manner claimed. In re Rouffet, 149 F.3d 1350 (Fed. Cir. 1996), 47 USPQ 2d (BNA) 1453. "To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or implicitly suggest the claimed invention or the Examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references." Ex parte Clapp, 227 USPQ 972, 973. (Bd.Pat.App.&Inter. 1985). The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. In re Mills, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Furthermore, although a prior art device "may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so." In re Mills 916 F.2d at 682, 16 USPQ2d at 1432; In re Fitch, 972 F.2d 1260, 23 USPQ2d 1780 (Fed. Cir. 1992).

Therefore, Applicants believe that independent claims 11 and 21 and their respective dependent claims are distinguishable over the cited prior art references. Accordingly, Applicants respectfully request the rejections under 35 U.S.C. §102(e), and 35 U.S.C. §103(a) be withdrawn.

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Conclusion

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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Dated: June 15, 2006

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